B.C. Hydro

Keenleyside Transmission Corridor Selection Studies

Corridor Alternatives Summary
by B.C. Hydro

Summary of preliminary environmental assessment studies for Hugh Keenleyside Transmission by Tera Environmental Consultants Ltd.

July 1982

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KEENLEYSIDE TRANSMISSION CORRIDOR SELECTION STUDIES

CORRIDOR ALTERNATIVES SUMMARY

BY B.C. HYDRO

SUMMARY OF PRELIMINARY ENVIRONMENTAL ASSESSMENT STUDIES

FOR HUGH KEENLEYSIDE TRANSMISSION

BY TERA ENVIRONMENTAL CONSULTANTS LTD.

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KEENLEYSIDE TRANSMISSION CORRIDOR SELECTION STUDIES

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PREFACE

B.C. Hydro is planning to submit an application to the Ministry of Energy, Mines and Petroleum Resources for an Energy Project Certificate for the Keenleyside and Murphy Creek hydroelectric generation projects. Included in the application will be information on the transmission requirements associated with each of the generation projects.

As part of the preparation for the application, engineering, economic and environmental studies have been carried out to identify feasible transmission corridors and to evaluate their suitability. This report, divided into Sections A and B, presents summary information for the Keenleyside project. Section A is a synopsis of pertinent information relating to engineering, economic and environmental factors and concludes with a corridor nominated as the best overall choice. Section B is a summary of the environmental impact of a transmission line in each corridor and has been prepared by Tera Environmental Consultants Ltd. In both sections the lengths of the corridors are based on map measurements and are subject to change depending on final alignment. This information is being made available prior to the beginning of the public consultation program which will include meetings to be held in areas potentially affected by the location of transmission lines.

The purpose of the consultation program is to provide the public an opportunity to express their comments and concerns relating to the various corridor alternatives. The results of the meetings will be placed on record and will be considered along with engineering and cost information in arriving at the selection of a corridor to be included in the application for the generation project.

More information on the environmental aspects of the transmission corridor can be found in the report entitled "Preliminary Environmental

Assessment Studies for Hugh Keenleyside Transmission", May 1982, prepared by Tera Environmental Consultants Ltd. of Vancouver. Copies of the summary reports and the environmental reports for transmission for both this project and the Murphy Creek project are available at public libraries in Trail, Castlegar and Nelson and from the B.C. Hydro office in Vancouver. If you require further information, please contact:

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A

CORRIDOR ALTERNATIVES SUMMARY

BY B.C. HYDRO

CORRIDOR ALTERNATIVES SUMMARY

(a) Project

B.C. Hydro is evaluating the feasibility and resultant implications of constructing hydroelectric generation facilities on the Columbia River in the Trail/Castlegar area. These projects would include the addition of generation capability to the existing Hugh Keenleyside Dam northwest of Castlegar and the construction of a new dam, Murphy Creek, at St. Mary's Rock approximately 3 km upstream of Trail.

The Hugh Keenleyside Dam was originally constructed under the terms of the Columbia River Treaty for the purpose of stream regulation and flood control. It will continue to fulfill that function. The addition of generation facilities would provide about 850 billion watt hours per year (850 GW.h/a) of electrical power from an installed capacity of approximately 210 million watts (210 MW). The new Murphy Creek Dam would provide about 2000 billion watt hours per year (2000 GW.h/a) from an installed capacity of approximately 300 million watts (300 MW).

Development of these generation projects would require high voltage lines to transmit power from the dam sites to the B.C. Hydro electric grid. System studies indicate that a single 230 000 V (230 kV) transmission connection should be considered between Keenleyside and the existing Kootenay Canal Substation. A similar link is under study between the Murphy Creek Dam site and the existing Selkirk Substation as well as a line between Keenleyside and Murphy Creek. The Keenleyside to Kootenay Canal and Keenleyside to Murphy Creek study area and corridors are shown in Section B of this report, "Summary of the Preliminary Environmental Assessment Studies for Hugh Keenleyside Transmission" Fig. 1 and Fig. 2.

(b) Corridor Studies

Each of the corridors shown on Fig. 2 was studied for technical feasibility and environmental impacts that would be associated with routing transmission along the corridor. Capital cost (including overhead, inflation, interest during construction and right-of-way acquisition is included in the following corridor comparisons for a single circuit wood pole H-frame (as shown in Fig. 3 and 4) 230 kV transmission line.

B.C. Hydro contracted Tera Environmental Consultants Ltd. of Vancouver to carry out an environmental assessment of all these corridors. The consultants conducted two separate studies:

1. Transmission for Keenleyside which includes the Keenleyside to Kootenay Canal and Keenleyside to Murphy Creek corridors.

2. Transmission to Murphy Creek which includes the Murphy Creek to Selkirk corridors.

The consultant produced a preliminary environmental assessment report for each of these study areas. A summary of that environmental evaluation prepared by the consultant for the corridors associated with Keenleyside follows. A separate summary document entitled "Murphy Creek Transmission Corridor Selection Studies" is provided for the Murphy Creek corridors.

(c) Corridor Comparison

The consultants ranked each corridor based on the potential environmental impact of 230 kV transmission routed along the corridor. A cost comparison and technical route evaluation was undertaken by B.C. Hydro. A preferred corridor was identified taking all these factors into consideration.

Three corridors were considered technically feasible between Keenleyside and Kootenay Canal and one between Keenleyside and Murphy Creek. Each route is briefly described below.

(i) Keenleyside to Kootenay Canal

Slocan Corridor (24 km) - This corridor proceeds directly northeast from Keenleyside across the southeastern flank of Ladybird Mountain to a crossing of Norns Creek north of Pass Creek. From here it traverses the north slope of the Pass Valley until it turns southeast across Highway 6 and the Slocan River near Langill Creek. A number of route options which generally parallel either the existing Ashton Creek to Selkirk 500 kV line or W.K.P. & L Lines between the Slocan River and Kootenay Canal near south Slocan are being investigated to minimize any impact the additional line may have.

The terrain over most of the route can be classified as moderate with a few steep rocky sections flanking Norns Creek. There is some general logging and forestry access over most of the route with good access near Keenleyside and South Slocan. Minimal clearing will be required between Norns and Langill creeks due to extensive burn areas and rocky terrain.

Construction cost including overhead, interest during construction, inflation and right-of-way acquisition is estimated to be in the range of $8.4 million depending on the route option selected in the vicinity of South Slocan and Kootenay Canal.

The environmental consultants have identified the Slocan Corridor as the alternative which would cause the least environmental impact of the three corridors considered (see Section B, page 6, following.)

Pass Creek Corridor (26 km) - The first 7.5 km of this corridor out of Keenleyside are the same as the Slocan Corridor. The corridor then swings eastward across the Pass valley immediately north of the community of Pass Creek and traverses around the base of a set of extensive rock bluffs on the east side of the valley. It then traverses the southeast side of the Pass Valley at a relatively low elevation to an area south of Krestova. At this point it swings sharply southeastward over the northeast flank of Sentinel Mountain to a point near the confluence of the Slocan and Kootenay rivers. The line would cross the Kootenay River adjacent to the Inland Natural Gas Ltd. pipeline crossing. From here it would parallel the existing 230 and 500 kV transmission lines to Kootenay Canal.

The Pass Creek Corridor is generally more accessable and the terrain is somewhat easier than the Slocan Corridor, however it traverses more heavily forested areas. This will increase clearing costs and make the right-of-way more visible particularly in traversing the steep slopes over the northeast flank of Sentinel Mountain near Shoreacres.

Construction cost including the right-of-way acquisition, overhead, interest during construction and inflation is estimated to be $8.7 million.

The environmental consultants have identified this corridor as a second choice based on environmental considerations (see Section B, page 6, following).

Robson Corridor (27 km) - This corridor is the longest of the three corridors being considered between Keenleyside and Kootenay Canal. It proceeds east out of Keenleyside along the north side of the Columbia River above Robson and crosses

Norns Creek above the series of small dams and waterfalls approximately 2.5 km north of its confluence with the Columbia. It then ascends the steep western slope of Sentinel Mountain and traverses a bench around the south and east sides of the forestry lookout tower. The corridor then descends Sentinel Mountain to Highway 3A and crosses the Kootenay River approximately 3 km north of Brilliant. It adjoins the existing Kootenay Canal to Selkirk right-of-way at Glade Creek and follows it north to Kootenay Canal.

The Robson corridor traverses the roughest terrain of all the corridors particularly in the ascent and descent of Sentinel Mountain. The cleared right-of-way in these areas may also be particularly visible from the surrounding communities. The main advantage of this corridor, like the Pass Creek corridor is the avoidance of the possible difficulties at South Slocan and Kootenay Canal.

Construction cost including overhead, interest during construction, inflation and right-of-way acquisition is estimated to be $9.1 million.

The environmental consultants found this alternative to be the least preferred of the three corridors with significant potential impacts on settlement patterns, recreation and heritage sites (see Section B, page 7, following).

(ii) Hugh Keenleyside to Murphy Creek Corridor (24 km)

This corridor proceeds almost directly south from Keenleyside to Murphy Creek. It crosses Robson Ridge to a crossing of Highway 3 and Blueberry Creek approximately 9 km up the valley from Kinnaird. From this point it heads southward across

China, Sullivan and Murphy creeks on the eastern slopes of Mount Mackie. The line would pass behind the community of Oasis then swing sharply eastward between Oasis and Riverdale on the north side of Hanna Creek. The line would then loop into the Murphy Creek powerhouse on either the east or west banks of the Columbia River depending on the ultimate layout of the dam which is presently under study.

The Keenleyside-Murphy Corridor traverses mountainous terrain of medium construction difficulty for the most part. Much of the area has been logged which provides generally good access. The construction cost for transmission along this corridor, including the overhead, interest during construction, inflation and right-of-way acquisition, is estimated to be $10.7 million.

The environmental consultants have also evaluated this corridor (see Section B, page 7, following).

(d) Conclusions

1. The environmental consultant has recommended the Slocan Corridor as the one which will result in the least environmental impact. B.C. Hydro has taken this advice into account in an overall evaluation which includes technical, economic and environmental information and considers that the Slocan Corridor would be the best overall corridor for a transmission connection between Keenleyside Dam and Kootenay Canal Substation.

2. There is only one reasonable corridor from Keenleyside to Murphy Creek which can be considered a best overall corridor.

B

SUMMARY OF PRELIMINARY ENVIRONMENTAL ASSESSMENT STUDIES FOR HUGH KEENLEYSIDE TRANSMISSION BY TERA ENVIRONMENTAL CONSULTANTS LTD.

SUMMARY OF THE PRELIMINARY ENVIRONMENTAL ASSESSMENT STUDIES FOR HUGH KEENLEYSIDE TRANSMISSION

Introduction

In January of 1982 TERA Environmental Consultants Ltd. was contracted by B.C. Hydro to conduct environmental studies for the transmission to connect the planned hydroelectric generation facilities at the Hugh Keenleyside dam northwest of Castlegar into the B.C. Hydro electric grid. At the present time there are no generation facilities at the Hugh Keenleyside Dam which was built under the terms of the Columbia River Treaty to provide stream regulation and flood control. The planned voltage for transmission lines from the Hugh Keenelyside station is 230,000 volts (230kV) whether it is connected to Kootenay Canal or to Murphy Creek and Selkirk Substation. One set of corridor options would connect the proposed Hugh Keenleyside Generation Station to the Kootenay Canal Substation. An additional corridor option would connect the generation station to the proposed Murphy Creek generation station, and from there to Selkirk substation southeast of Trail. See Figure 2.

The study is designed to meet the requirements of a preliminary planning environmental assessment report in support of the study requirements for the generation project as set by the B.C. Ministry of Energy, Mines and Petroleum Resources. Public consultation will be held to determine the most favorable location for the transmission lines before detailed studies are undertaken. Social concerns will be dealt with in context with the public meetings. Specifically the objectives of the preliminary environmental assessment study are:

- to provide information on the environmental aspects of transmission from the proposed Hugh Keenleyside Generation Station to Kootenay Canal Substation from published information, field reconnaissance and communication with government agencies;

- to identify environmentally feasible corridors for the proposed transmission line development;
- to rank the feasible transmission line corridors between the proposed Hugh Keenleyside generation station and the Kootenay Canal Substation in order of expected cumulative environmental impacts.
- to provide overview information on the environmental aspects of the proposed transmission line between the Hugh Keenleyside dam and the proposed Murphy Creek damsite; information on transmission corridors between Murphy Creek damsite and Selkirk Substation is provided in a separate report (Preliminary Environmental Assessment Studies for Murphy Creek Transmission) and Summary.

Setting

The study area lies in a transition zone between the moist Selkirk Mountains to the northeast, and the drier middle Columbia Valley to the southwest. See Figure 1. Summers are generally hot and dry, while winters are cool and snowy. The terrain in the study area is dominated by the Selkirk Mountains on the east and Monashee Mountains on the west. These mountain ranges are divided by the deep valley of the Columbia River. The mountainous upland consists primarily of a complex of rounded ridges ranging in elevation from 1500 m to 2000 m which have been subdued by heavy glaciation. The upland is divided into several deep blocks by the valleys of the Columbia, Kootenay, and Slocan Rivers. These valleys are bounded by a series of fluvioglacial terraces up to 150 m in height. Bedrock exposures are common along the floor of the Kootenay River valley. These exposures have formed a series of rapids and waterfalls, which have been developed for hydroelectric power. A fourth valley, Pass Valley, connects the Columbia and Slocan valleys at an elevation of 600 m.

These ranges of elevation have greatly affected vegetation and human settlement. The study area is within the Interior Cedar Hemlock and Engelmann Spruce-Subalpine Fir biogeoclimatic zones. The Interior-Cedar Hemlock is by far the most common and confined to elevations below 1500 m. Major vegetation types include: subalpine parkland and alpine tundra above 1,800 m, forested areas, early successional vegetation (mainly shrubs) in logged areas affected by fire and smelter fumes, scattered wetlands, and cultivated areas in the major valley. Wildlife resources include elk, mountain goats, deer, bear, beaver and a wide variety of furbearers. Fisheries resources include rainbow trout, Dolly Varden, white fish, Kokanee, char, walleye, and sturgeon. Sport fishing is important to the area.

Human activity is concentrated in the major valleys. The City of Castlegar lies at the centre of the study area. It is a centre for trade, transportation, and tourism in the region. Many smaller communities are scattered along the valley bottoms. These include South Slocan, Krestova, Robson, Raspberry and Crescent Valley. With the exception of South Slocan, the larger communities in the area lie outside of the feasible corridors. Rural settlement includes small farms and orchards, small beef and horse ranches, rural residences, and hobby farms. These are located along the Kootenay, Slocan and Columbia Rivers and along Norns and Goose Creeks.

The Columbia River-Arrow Lakes area west of Castlegar is the most significant recreational area. Recreational activities in the study area include sport fishing, boating, camping, hiking, riding and canoeing. The valleys of the study area are known to have been important to the early Salish peoples. Later settlement included prospectors, miners, and the agricultural communities of Doukhobors.

Study Approach

To accomplish the objectives of the preliminary environmental assessment study, environmental issues were divided into thirteen disciplines: climate, terrain, hydrology, mining, vegetation, agriculture, forestry, wildlife, fish, visual analysis, settlement, recreation and heritage. Professional consultants in each of these disciplines followed carefully developed methodologies to collect inventories of their specialty, assess the potential impacts of the proposed transmission line development and rank the feasible corridors that connect the proposed Hugh Keenleyside Generation Station with the Kootenay Canal Substation.

B.C. Hydro provided information on the Hugh Keenleyside Transmission Line Studies (January, 1982) which indicated three feasible corridors between the proposed Hugh Keenleyside Generation Station and the Kootenay Canal Substation, as well as a single feasible corridor between the proposed Hugh Keenleyside Generation Station and the proposed Murphy Creek Generation station. The consultants reviewed this information and enlarged some of these corridors. The consultants saw no environmental reason for adding additional corridors between the proposed Hugh Keenleyside Generation Station and the proposed Murphy Creek Generation Station.

The consultants identified environmental constraints on transmission line development within the corridors and assessed the potential impacts of transmission line construction and operation within each feasible corridor.

Specific constraints and impacts, and the methodology used for inventory and assessment purposes for each discipline are described in the Preliminary Environmental Assessment Report. Assessments of the feasible corridors and the corridor selection process are also included.

Recommendations for Mitigation Measures and Specific Recommendations are provided along with recommended terms of reference for Impact Assessment Studies.

Major Potential Impacts

The following is a summary of the areas with a high potential for significant impacts in each of the feasible corridors. Many of the impacts identified in the study area could be reduced or overcome by careful route selection and mitigation procedures.

Areas with a high potential for impacts that are located at either the proposed Hugh Keenleyside Generation station or the Kootenay Canal Substation are common to the three feasible corridors connecting these two points. These impacts are briefly reviewed in the following paragraph but not addressed in the following corridor summaries.

Potential Impacts Common to All Corridors

There is a high potential for adverse impacts on wildlife because of the winter ungulate range in the area around the proposed Hugh Keenleyside generation station. This area is also visually sensitive. The area around the Kootenay Canal Substation has a concentration of existing transmission lines, and careful route selection would be required in this area to minimize visual impacts and avoid conflicts with future settlement in the South Slocan area. There are also good forest sites and known heritage sites in the area around the substation.

Slocan Corridor

Potential impacts in the Slocan Corridor may affect wildlife, fish, and agriculture. The corridor traverses 5.3 km of Canada Land Inventory Class 1 and 2 winter range for deer and elk and 17.7 km of Class 3 winter range for deer. As much of the potential impact area is also traversed by the other corridors there is not much to choose among the three corridor alternatives. Areas of potential impacts for fish occur at Norns Creek, the Slocan River and Goose Creek. Potential impacts on minor stream crossings seem easily mitigated. There is a potential for impacts on agriculture near Pass Creek. Transmission line development could discourage irrigation development on the prime agricultural land north of Krestova. Careful route selection could avoid this area. Other potential problems in this corridor include: crossings of three community watersheds (Langill Creek, McDermid Creek, Watts Creek) and damage to visually sensitive areas in Goose Creek Valley and Slocan Ridge..

Pass Creek Corridor

The major concerns in the Pass Creek Corridor are forestry, vegetation and visual resources. Pass Creek contains the highest percentage of forested land of any of the corridors (82%). For this reason it is the least preferred by the forestry and vegetation disciplines. The visually critical knoll at the southern end of the Goose Creek Valley should be avoided. Location of a transmission line immediately adjacent to the mouth of the Slocan River could result in a potential impacts on the recreation opportunities of the beach and river bank.

Other potential problems are associated with the crossing of the Norns Creek Watershed which is a community water supply area. This area includes small farms, orchards, and rural residences. There is a potential for terrain impacts south of Goose Creek. Fisheries

impacts could occur at the crossing of Norns Creek. Three heritage sites are located at the confluence of the Slocan and Kootenay Rivers. The corridor traverses 5.3 km of Class land 2 winter range for deer and elk and 20 km of Class 3 winter deer range.

Robson Corridor

The Robson Corridor could affect terrain, water resources, visual resources, settlement, recreation, and heritage. The corridor crosses the only lacustrine deposit in the feasible corridors at Norns Creek which could affect both terrain and water resources. Other impacts could be associated with the community water supplies for Robson and Raspberry. Possibly the most significant negative impacts would be on settlement. The communities of Robson, Raspberry, Gibson Creek, Tarrys, and Thrums could be adversely affected. Potential impacts to recreation occur at Norns Creek and the Kootenay River. The total of 9 known heritage sites within this corridor make it the least preferred from a heritage viewpoint. Potential impacts to agriculture occur at Norns Creek and either side of the Kootenay River. This corridor traverses 6.4 km of Class 1 and 2 winter range for deer and elk and 18.4 km of Class 3 range for deer.

Hugh Keenleyside - Murphy Creek Corridor

The high elevation of the central part of this corridor creates areas of potential terrain problems in the form of avalanche and rockslide activity. Large areas in this corridor have been logged. This logging reduces the potential impacts due to transmission line development for hydrology and vegetation. The corridor traverses 2.3 km of mountain goat range above the Hugh Keenleyside Dam and 6.8 km of Class 3 winter range for deer. Several claim groups related to uranium exploration are located in the China Creek-Sullivan area, however problems with mining in this area are not expected. The high elevation and area logged reduce

transmission impacts on forestry in this corridor. Impacts on agriculture, fish, and settlement are expected to be low and visual impacts will be greatly reduced if the route alignment avoids crossing west of the Hugh Keenleyside dam.

Selection of a Preferred Corridor

Based on the impact assessments by each consultant, the concensus of the consultants was as follows:

- The Slocan Corridor is the most preferred corridor if only environmental concerns are considered.

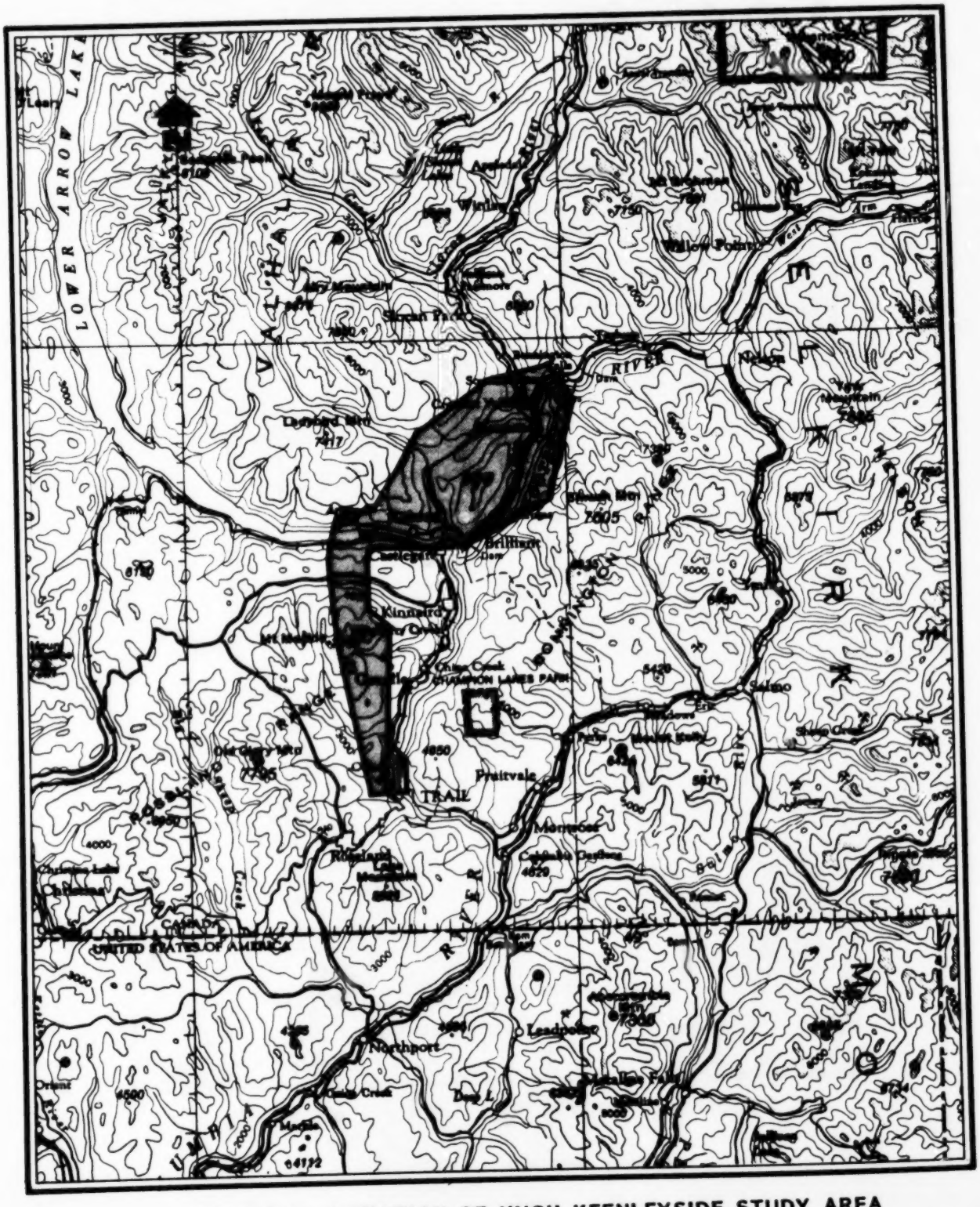
- The Pass Creek Corridor is a close second to the Slocan Corridor.

- The Robson Corridor is the least preferred corridor by a substantial margin.

- The general level of potential impacts in the Hugh Keenleyside-Murphy Creek Corridor is no higher than the other three corridors but it was not included in the ranking procedure.

Conclusion

The consulting team felt there was a clear environmental preference for either the Slocan Corridor or the Pass Creek Corridor. The importance of settlement and visual resources to the area was a major factor in preferring the Slocan Corridor and specific areas of potential impacts can be avoided in the Slocan Corridor.


LOWER ARROW LAKE
RIVER
Trail
Kinnaird
Pratt Creek
Pratt Creek
Pratt Creek

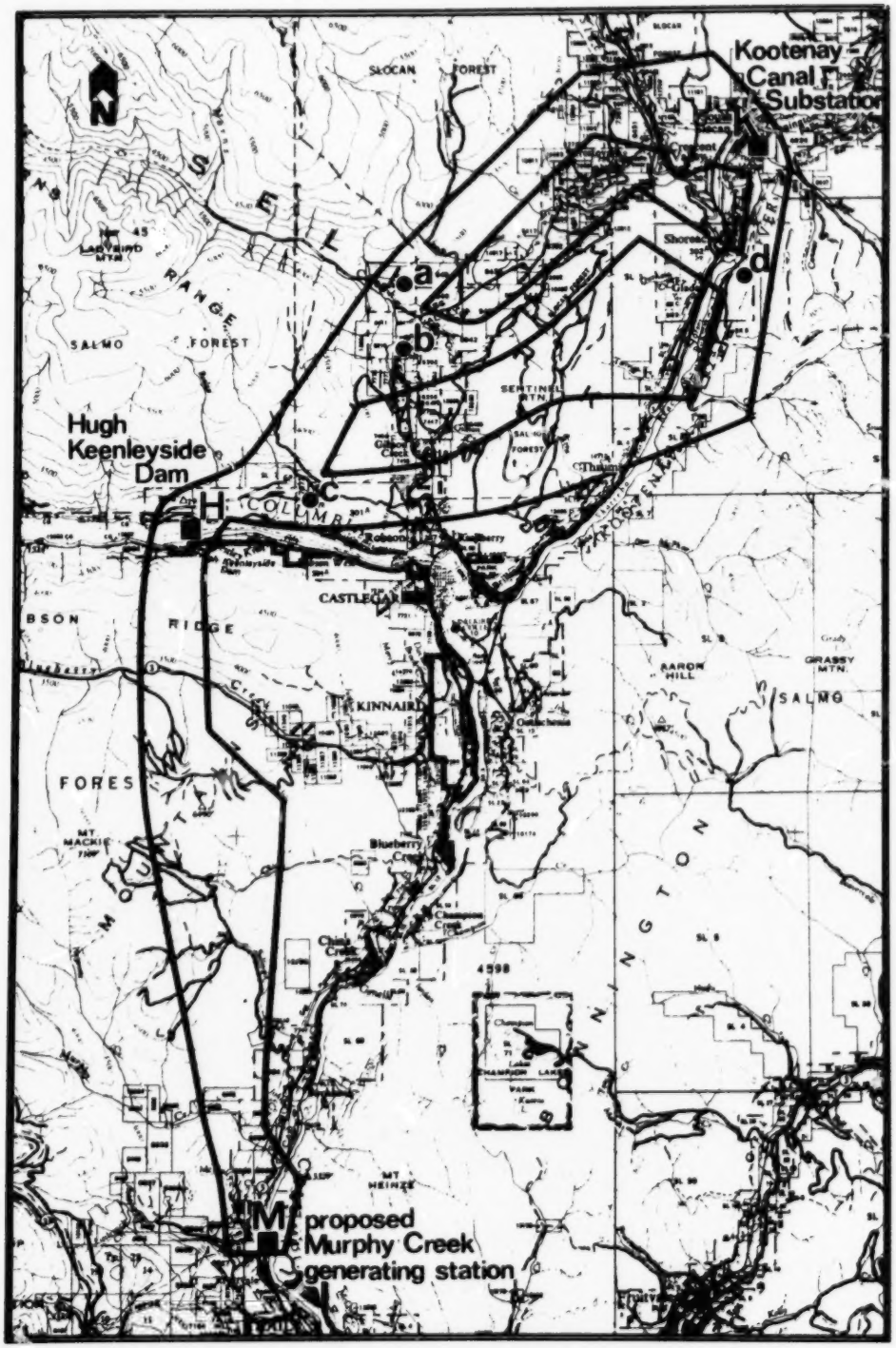
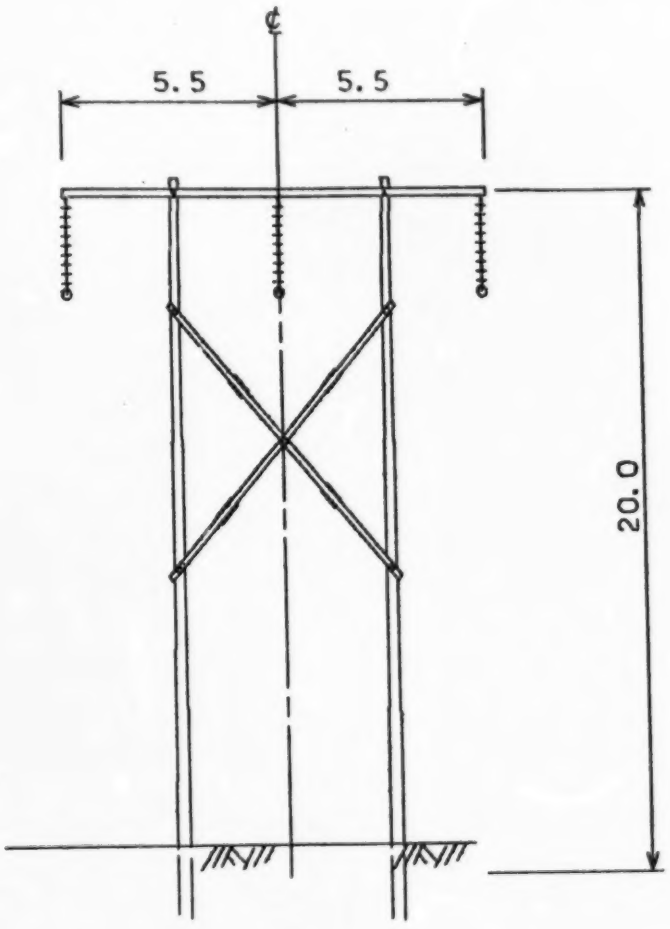


FIGURE 2: HUGH KEENLEYSIDE CORRIDORS

CORRIDOR	ROUTING	LENGTH
Slocan	H-a-K	24 km
Pass Creek	H-b-d-K	26 km
Robson	H-c-d-K	27 km
Hugh Keenleyside - Murphy Creek	H-M	24 km

Corridor boundary

Scale of Kilometres



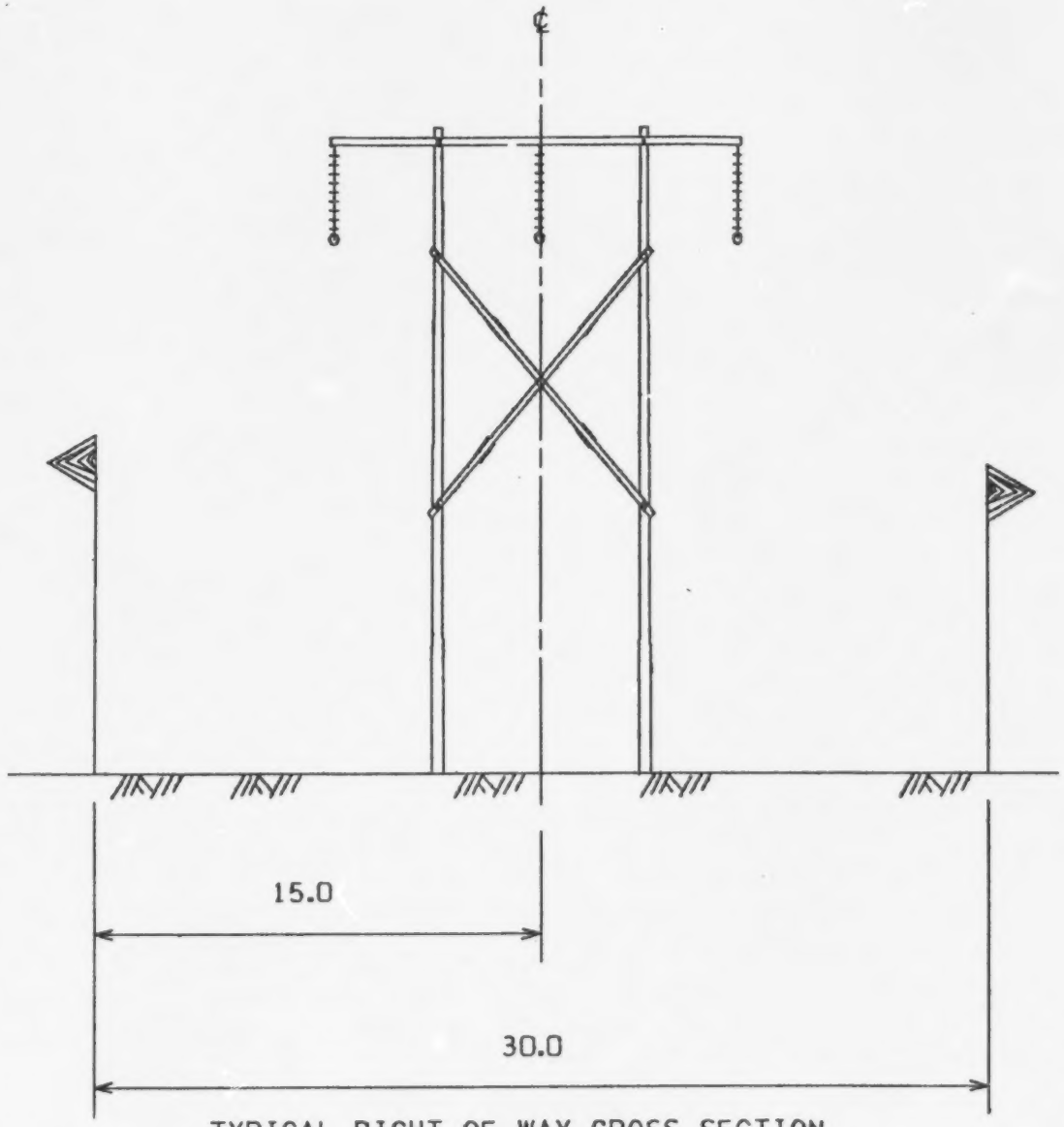
NOTES:

1. ALL DIMENSIONS SHOWN ARE IN METRES.
2. THE HEIGHT SHOWN IS AN AVERAGE HEIGHT.

KEENLEYSIDE/MURPHY CREEK 230 kV TRANSMISSION

WOOD POLE STRUCTURE OUTLINE

FIGURE 3



TYPICAL RIGHT OF WAY CROSS SECTION

NOTES:

1. DIMENSIONS ARE PRELIMINARY .
2. ALL DIMENSIONS ARE IN METRES.

KEENLEYSIDE/MURPHY CREEK
TRANSMISSION
TYPICAL RIGHT OF WAY CROSS SECTIONS
FIGURE 4